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THE GENES OF REPRODUCTIVE SYSTEM OF *CAPSICUM* GENUS AND THE SEARCH FOR WAYS OF THEIR APPLICATION IN CONDITIONS OF COVERED SOIL IN UKRAINE

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Pepper (*Capsicum* genus) is one of the most important vegetables and spices in the world. There is constant work in studying the genetics of pepper. New genes and genetic markers are discovered, previously discovered ones are studied in a finer detail. **Aim**. The aim of this work was to describe and systematize currently known genes of the reproductive system of *Capsicum* genus plants and to highlight the issue of using recessive mutant genes in the selection process while creating new varieties and hybrids of sweet pepper. **Methods**. The world collection of sweet pepper, current varieties and hybrids of different countries, our own selection material was used to classify reproductive genes in the selective studies. The experiments were conducted in conditions of plastic and glass greenhouses according to modern methods. **Results.** The data obtained were systematized into the following groups of genes: functional and genetic sterility, cytoplasmic male sterility, fertility restoration, female fertility and the ones, responsible for flowering processes. A part of described genes may be used in heterosis plant breeding and while creating the original initial material. The examples of using recessive mutant genes while creating new varieties and hybrids of sweet pepper were presented along with their short characteristics. New varieties and hybrids of sweet pepper were introduced into the State register of varieties of plants, suitable for growing in Ukraine. **Conclusions**. The characterized genes may be used in genetic and selection studies. A number of new commercial varieties and hybrids of sweet pepper were created using recessive mutant genes.

Keywords: pepper, gene, selection process, reproductive system, sterility, fertility.
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INTRODUCTION

Sweet pepper is one of the most important vegetables, enriching human ratio with necessary vitamins, microelements, dietary fibers, and wholesome sugars. The representatives of *Capsicum* genus are widely used in food canning, pharmaceutical and other branches of industry [1].

Capsicum is a crop of tropic and subtropic regions of South America. It covers about 30 species, including five main cultivated ones, namely, *C. annuum* L., *C. frutescens* L., *C. chinense* Jacq., *C. baccatum* L. and *C. pubescens* Ruiz and Pavon [2].

According to the biological criteria, pepper is a perennial self-pollinating plant, but in Ukraine's conditions it is a one-year plant, referred to optionally self-pollinating plants. Depending on weather conditions, transpollination may reach 40–60 %. Pepper flowers may be pollinated both with its own pollen, and with the pollen of another plant, brought by an insect. Limp and bent flowers are usually pollinated with the pollen of the same plant. Hot pepper is more likely to have cross-pollination, compared to sweet pepper [3].

Most varieties of *Capsicum* are diploid ($2n = 2x = 24$), but there are several varieties with $2n = 2x = 32$.

Capsicum has a large genome, the size of which fluctuates in the range of 7.65 thousand bp for *C. annuum* to 9.72 thousand bp for *C. pubescens*, and the average value is approximately 8.42 thousand bp. [4].

The genes of *Capsicum* have been studied since 1912, when Weber started his studies on the inheritance of several traits [5]. The works in *Capsicum* genetics have been conducted by scientists of many countries: in England – Aktins and Sherard, in India – Deshpande, in Japan – Ikeno, in the United States – Halstead and Dale [5, 6]. In particular, the scientists paid much attention to the reproductive system, including genetic, cytoplasmic, functional male sterility, as well as female sterility and genes of fertility restoration [7].

The aim of the current work was to describe and systematize known genes of the reproductive system of *Capsicum* genus plants and to suggest their usage in the creation of new varieties and hybrids of sweet pepper in the conditions of Ukraine's protected soils.

MATERIALS AND METHODS

Plant breeding experiments with sweet pepper in the conditions of protected soils have been conducted by us since 2001 on the basis of the Research and Education Center of Covered Soil at the Scientific and Research Production Agricultural Complex Pushcha-Vodytsia. The work was started with the study of the world collection of varieties and hybrids of sweet pepper of different countries. Over 400 specimens have been analyzed during the years of the studies. About 1,000 specimens of the lines of our own selection and 1,000 of new hybrids F_1, selected by us, were also used in the studies.

The experiments were conducted according to common methods, described in [3, 8, 9] by the following trends: the creation of initial material for the selection of varieties and heterosis plant breeding, the obtaining of new varieties and hybrids F_1 for the conditions of plastic and glass greenhouses. Soil was used as a substrate in plastic greenhouses and gravel – in glass greenhouses. The plants were grown with drop irrigation and optimal supply of organo-mineral fertilizers. The scheme of planting was as follows: 70 × 35 cm – in plastic greenhouses, and 100 × 60 with a tape – in glass greenhouses. The plants were formed into one stalk. The area of the experimental plot was 5 sq.m.

The variety testing of the best new hybrids F_1 was conducted with three repeats. The best hybrids F_1 of domestic and foreign selection were used as standards. About 25–30 hybrids F_1 were tested in the breeding ground of the main variety testing every year.

The evaluation of the collection and selection material involved the analysis of the morphological traits of the plant, the size, form and color of the pepper, its location, quality indices, and resistance to diseases.

Special attention was paid to the manifestation of marker genes in different generations and their association with economically valuable traits of sweet pepper. The combination capability of selection lines was studied in test crossing. The selection was conducted by Pedigree's method.

RESULTS AND DISCUSSION

The preconceptual work in planning the studies and forming the initial material for the selection and creation of hybrids involved the study of the availability of marker genes in sweet pepper, which could be used in the estimation and selection of hybrid populations and heterosis plant breeding. Considerable attention was paid to the genes, regulating the reproductive systems, in particular, genetic and cytoplasmic male sterility and the genes of fertility restoration, genes of male fertility, genes of female sterility and genes, responsible for flowering.

The analysis of literature data demonstrated that there are genes, which can be used as markers in the selection process. In our opinion, genes of functional male sterility, genetic male sterility, cytoplasmic male sterility, fertility restoration and genes, responsible for flowering processes are of special relevance.

Genetic and functional male sterility. The first scientists, who studied genetic male sterility, were Shifriss and Frankel, who discovered the first gene of male sterility *ms-1* in the spontaneous sterile mutant "All Big" in 1969 [10] (Table 1). Many scientists worked at the study of genes of male sterility. Table 1 presents the list of known genes of genetic and functional male sterility.

Cytoplasmic male sterility (CMS). CMS is widely used in modern heterosis selection of sweet pepper. It is a special type of deviation from the normal development of pollen, when pollen sterility is caused not by deviations in meiosis or spermiogenesis, but by the pathological vacuolization of cytoplasm of pollen grains in the process of development. CMS is conditioned by the specificities of cytoplasm, not by the presence of the gene of pollen abortiveness in the homozygous state (genetic sterility). CMS is inherited only in the maternal line. The main criterion of cytoplasmic inheritance is the result of reciprocal

Table 1. The genes of genetic and functional male sterility

Name (synonym)	Name and characteristic of trait manifestation	Refe-rence
DEG13	Gene of mRNA stress, related to the induction of the embryogenesis of microspores; participates in the embryogenesis of microspores in response to the heat stress	[11]
Dms	*Dominant genetic male sterility*; mutation of *ms*-5	[12, 13]
ds	*Desynapsis*; the univalents are formed with high frequency instead of normal formation of pairs in pachynema, in diakinesis and metaphase I; induces high level of sterility; modified genes may influence *ds*	[13]
fi-1; (mu- tant-1, fi)	*Filiform*; filiform leaves, irregular flowering; male sterility	[14, 15]
fi-2	*Filiform*, similar to fi-1; narrow cotyledons and leaves (3–4 mm); filiform petals; the pistil does not grow together with stamens, except for the ones, which originate from small-fruited varieties; incomplete male sterility	[16]
fms	*Functional male sterility*; degenerated corolla; withering of stamens leads to under-development of anthers and stigma; the anthers are closed with a long calyx; the mutant form of "Fudijian"	[17]
ms-1	*Genetic male sterility*; the anthers are small and wrinkled, without the pollen grains; gene ms-1 may be associated with one of the genes, influencing the pigmentation; the mutant form of "All Big"	[10, 18, 19]
ms-2	*Genetic male sterility*; wrinkled anthers, releasing many abortive (incapable of germination) pollen grains; the mutant form of "California Wonder"	[20]
ms-3	*Genetic male sterility*; wrinkled anthers, in some cases only a small number of fertile and sterile grains are formed; radiation-induced mutant of "Pasardjishka Kapia 794"	[21]
ms-4	*Genetic male sterility*; anthers are not completely reduced, they contain a small number of fertile and sterile grains; radiation-induced mutant of "Kapia 794"	[22, 23]
ms-6, ms-7	*Genetic male sterility*; wrinkled anthers of reduced size; sometimes only a small amount of fertile pollen is formed; all *ms*-1−*ms*-8 are non-allelic; radiation-induced mutant of "Zlaten Medal"	[19, 24]
ms-8	*Genetic male sterility*; wrinkled anthers of reduced size; sometimes only a small amount of fertile pollen is formed; radiation-induced mutant of "Zlaten Medal"; located on the lower chromosome arm P9	[19, 24, 25]
ms-9; (mr-9)	*Genetic male sterility*; gamma-radiation-induced male sterility	[12, 26]
ms-10; (mc-509)	*Genetic male sterility*; the mutant with male sterility, induced by ethylmethane sulfonate (EMS); ms-10 was revealed to be allelic to the isolated allele msk in Korea	[12, 26, 27]
ms-11; (mc-705)	*Genetic male sterility*; the mutant with male sterility, induced by EMS	[12, 26]
ms-12	*Genetic male sterility*; small and wrinkled anthers without any pollen grains; postmeiotic opening of microspores; non-allelic to *ms*-1 and *ms*-2; allelism to *ms*-alleles of Daskalov is unknown; the mutant of "Gambo"	[28]
ms-13; (ms)	*Genetic male sterility*; complete pollen sterility; postmeiotic opening of microspores; the mutant of "CA452-1"	[29]
ms-14	*Genetic male sterility*; the androecium transforms into a petal-like structure; the mutant of "Kalyanpur selection"	[30]
ms-15; (ms)	*Genetic male sterility*; the anthers are decreased by 50 %, of dark blue color; postmeiotic opening of microspores during the formation of male gametes; originated from "CA-960"	[31]
msc-1	*Genetic male sterility*; the spontaneous mutant was discovered in China; allelism to ms-1−*ms*-15 and smk is unknown	[32, 33]
msc-2	*Genetic male sterility*; the spontaneous mutant of "Ying Ge Bai Er" was discovered in China; allelism to *ms*-1−*ms*-15, *smc*-1 and smk is unknown	[34, 35]
ms_k	*Genetic male sterility*; the spontaneous mutant was discovered in Korea for *Capsicum annuum* L.	[28, 36]

Continued Table 1

Name (synonym)	Name and characteristic of trait manifestation	Reference
ms_p	*Genetic male sterility*; the spontaneous mutant was discovered in Korea for *Capsicum annuum* L.	[28, 36]
CaPME1	*Capsicum annuum anther-specific gene*; responsible for ripening and development of pollen in *C. annuum*; its manifestation is revealed only at the final stage of ripening of buds and in the open flowers of male fertile line, it was not discovered in the tissues of other organs (sepals, petals, pistil, roots, stalk or leaves), and any other parts of plants of the sterile line	[37]

Table 2.The genes of cytoplasmic male sterility (CMS)

Name (synonym)	Name and characteristic of trait manifestation	Reference
atp6	*Cytoplasmic male sterility*; CMS-associated gene; there are two copies in male sterile lines, one of which is not normal (pseudo)	[19, 39, 42]
coxII	*Cytoplasmic male sterility*; CMS-associated gene in *C. annuum*	[19, 39]
ms-5	*Cytoplasmic male sterility*; CMS; anthers are greatly reduced, no pollen grains while being cultivated in the open soil; in the conditions of covered soil some plants may form a small number of fertile pollen grains; radiation-induced mutant of “Kalinkov 800/7”	[23]
orf456	*CMS-associated mitochondrial genes*; causes male sterile phenotype in CMS-lines of chili pepper	[40]
orf507	*Semi-cytoplasmic male sterility*; one of the factors of cytoplasmic male sterility in CMS-lines; the presence of this gene alone does not cause complete sterility of pepper	[41–43]
Psy-atp6-2	*Mitochondrial male sterility gene*; impacts the activity of hydrolysis during ATP synthesis in mitochondria during pollen development, which leads to male sterility in pepper	[44]
(S) rf-1, rf-2; ((S) msms)	*Cytoplasmic male sterility*; CMS, controlled by two nuclear genes and a mutant cytoplasmic gene *S*; the origin of dominant alleles of both loci is necessary for pollen fertility restoration; the impact of mutant cytoplasmic gene S is revealed only in the homozygous recessive state of nuclear genes	[45–47]

Table 3. The genes of fertility restoration

Name (synonym)	Name and characteristic of trait manifestation	Reference
pr	*Partial restoration;* partial restorer of fertility; a recessive nuclear gene, associated with fertility restoration in CMS-lines of chili pepper; closely related to *Rf*-locus (its third allele); plants with partially restored fertility have normal anthers with a mixture of normal and abortive pollen grains, which are stuck to anther walls even after their cracking. It occurs only when pepper plants have sterile cytoplasm (*S*) and homologous recessive alleles *pr*	[19, 36, 38]
Rf	*Restorer-of-fertility;* the main dominant nuclear gene, restoring fertility in CMS-lines of chili pepper	[19, 36, 38, 48, 49]

crossings. The genes, controlling CMS, are described in Table 2.

While using CMS in the selection work of creating hybrid seeds, the obligatory stage is the fertility restoration (Table 3), conditioned by the participation of dominant allele genes. Thus, depending on the function, fulfilled by the pollinator regarding the sterile plant – fertility restoration or sterility securing – the hybrid progeny obtained will be either fertile or sterile. One of these genes is *Rf* [19, 36, 38]. If a pollinator turns out to be incomplete restorer of fertility, the hybrid progeny will have both sterile and fertile plants with different degrees of fertility *pr* [19, 36, 48−50].

Table 4. The genes of male fertility

Name (synonym)	Name and characteristic of trait manifestation	Reference
Camf1	*Capsicum annuum male fertile gene*; a specific gene of anthers; plays a relevant role in the development of pollen in *C. annuum*; was discovered only in anthers of the fertile line of "114B" pepper; belongs to the group of "early" genes	[54]
CaMF2	*Capsicum annuum male fertile gene*; a specific gene of anthers; plays a relevant role in the development of pollen in *C. annuum*; was discovered in the buds of the fertile line of "114B" pepper; belongs to the group of "early" genes	[53]
CaMF3	*Capsicum annuum male fertile gene*; a specific gene of anthers, which is revealed only in the buds at the late stage of development and in open flowers of the fertile line of "114B" pepper; belongs to the group of "late" genes; was discovered in the buds of the male fertile line "114B"	[55]
fl	*Folded leaf*; upward folded leaves, which creates the boat-like form; is manifested in young plants; partial fertility; originated from "PC 1"	[51]

Table 5. The genes of female sterility

Name (synonym)	Name and characteristic of trait manifestation	Reference
cfs	*Conditional female sterile*; strong plants with compact habit; normally developed flowers contain fertile pollen grains; obtained from M2 of population of cv. "Borjana"	[56]
fcf; (fc)	*Fasciflora*; female sterility, plants with pollen, fertile for 27–55 %, seedless fruit	[12]
fems	*Female and male sterility*; wrinkled pollen does not contain starch; many small seedless fruit; the mutant of line "4526"	[57]
fll	*Flowerless plant*; intense vegetative growth, obtained from "PC1"	[51]
fs	*Female sterile*; complete female sterility without any other previous phenotype manifestations; adult plants have weak multiflowered periphery; the mutant of PI 159276	[58]
Pf	*Parthenocarpic fruit*; no seeds; reduced size of fruit; the eggs start degenerating on the second day after the opening of the flower and degenerate completely after five days; pollen fertility is greatly reduced	[59]
sel-1	*Seedless*; normal pollen is formed, but eggs are poorly formed (deformed) and non-functional	[60]
sel-2	*Seedless*; deformed placenta (embryo sac); pericarp is thick and carnous; flowering takes place much later	[61]
sl-1; (sl)	*Styleless*; absence of normal style or stigma; incomplete female sterility	[62]
sl-2	*Styleless*; flowers are without a style or stigma, the ovary is not damaged, without the formation of fruit; female sterility; isolated from "Kalyanpur Red"	[63]
sp	*Spinach*; limited development of the stalk, many large leaves are formed into heavy body in close proximity to the surface of the soil; buds are completely blocked; mutant form PI 159280	[58]

Male fertility. There were previous reports on one recessive gene, controlling male fertility [7, 51, 52]. At present three more genes of male fertility have been determined [53−55] (Table 4).

Female sterility. Female sterility of sweet pepper is conditioned by different pathologies of female reproductive organs. The genes, controlling this trait, are presented in Table 5.

The genes of the reproductive system of *Capsicum* genus also include the ones, responsible for flowering: its presence, time of occurrence, its course, *etc*. Two recessive genes were listed in the previous lists of genes [7, 52], namely, *ef*, *nf*. We added two dominant genes, discovered by Cohen *et al*. and Tan Shu *et al*. to this list (Table 6).

The genetics of *Capsicum* has been studied for almost a century, the selection of this genus has been greatly improved due to the study of genetic and cytoplasmic male sterility, male fertility and its restoration, female sterility and genetic control over flowering.

The application of marker genes allowed accelerating the selection process for sweet pepper and reducing the volumes of selection breeding grounds. The application of marker genes of phenotype traits (the form of a fruit, the color of a fruit in technical and biological ripeness, growth type, pericarp thickness) in the maternal line allowed controlling the degree of hybridism, which facilitates the system of hybrid reproduction.

For instance, while selecting genotypes with genes *dm*, *dt*, *sp*, *ef*, short, early-ripening forms were obtained with determinant plants, necessary while growing in temporary covers and plastic greenhouses for early harvest.

Usually the selection of phenotypes (marker genome P, cone-like fruit) was aimed at the formation of early

Table 6. The genes, responsible for flowering

Name (synonym)	Name and characteristic of trait manifestation	Reference
Cas, Ca-AN	*Flowering related genes*; responsible for the activity of flower meristems; epistatic to other genes, controlling the transition to flowering with the corresponding composition of flowers	[64]
ef	*Early flowering*; flowering occurs 20–25 days earlier than for “PC 1”; there are a few seeds formed; obtained from “PC 1”	[51]
nf	*Nonflowering*; no flowers are formed during the cultivation season	[65]
Nle	Participates in the regulation of flowering period in the population of *Capsicum*; was discovered in P2-chromosome in 2012, confirmed in 2014	[64, 66]

Table 7. New varieties and hybrids F_1, introduced into the State register of varieties of plants, suitable for growing in Ukraine

Name of variety, hybrid	Trait			
	Growth type	Fruit form	Fruit color	
			in technical ripeness	in biological ripeness
Soniachny – early-ripening, cone-like fruit, light color/red	Dt	P	sw_2	Ccs
Vatag – early-ripening, cube-like fruit, dark green/red	Dt	fb	sw_3	Ccs
Dobirny – early-ripening, cube-like fruit, dark green/red	Dt	fb	sw_3	Ccs
Lysko – early-ripening, cube-like fruit, light yellowish-green/yellow	Dt	fb	sw_2	Y
Aborygen – early-ripening, tomato-like fruit, dark green/red	dt	O	sw_3	Ccs
Advokat – early-ripening, tomato-like fruit, light green/yellow-orange	dt	O	sw_2	Y
F1 Anika – middle early, cube-like fruit, dark green/red	Dt	fb	sw_3	c-1 and y

ripeness, light color of the fruit and pericarp of medium thickness.

Evaluating the plants by gene *fb*, the task was to obtain cube-like fruit, usually of dark green color, thick pericarp, middle and late ripeness. The genotypes with upward direction of fruit were formed using gene *up*. The process of checking involved the selection of crud and ripe fruit of different colors: light green (gene sw_1), bright green (gene sw_2), violet (in the intermediate phase of ripeness, gene *im*), yellow (gene *y*), orange (interaction of genes *c* and *y*) and brown (gene $cl^+ y^+$). The plants with a small amount of gene Pf or without it were selected for enhanced early ripeness, cold endurance, high yield and taste qualities. The heterosis plant breeding required the presence of gene *ms-5*, responsible for CMS, in the genotype. And the reproduction of hybrids F_1 required the presence of genes-restorers of fertility (gene *pr*). The plants in the phase of seedlings can be selected at early stages of development (gene *rl* – round leaves, gene *aur* – yellow cotyledons and leaves).

The process of selection resulted in our creating varieties and hybrids F_1 of sweet pepper, which were recommended for growing in Ukraine by the State Committee for the Testing of New Varieties of Agricultural Plants (Table 7).

A number of hybrids are being tested. These include plants with different forms of fruit and color: red, yellow, orange and violet ones.

CONCLUSIONS

The study of genes of *Capsicum* genus is going on. In particular, important tasks are the determination of allelic relations between similar genes, obtaining of new gene mutants, study of homologous genes of other varieties, determination of the location of loci, responsible for certain traits, within chromosomes, genome mapping, creation of molecular markers of genes and defining the functions of genes.

The results of studies obtained may be efficiently used to create new genotypes of sweet pepper. Special attention should be paid to determining features of plant habit, taking into consideration the requirements of technologies of open and protected soil; size, form, color of fruit, marking of biochemical processes, responsible for quality traits of fruit and their resistance to biotic and abiotic factors.

There is a need for intensification of the study of marker genes, promoting the manifestation of heterosis, including genes of sterility, securing and restoration of sterility, as well as for the determination of interrelations of such genes and economically valuable traits. There is an evident requirement for the application of marker genes while planting hybrids of the first generation, which will allow visual control of hybridism degree and purity of initial forms at all the stages. The use of molecular markers with the purpose of obtaining an increased number of substances of dietary, protecting and healing value in sweet pepper seems to be a promising trend.

The application of a number of marker genes allowed us to create commercial varieties and hybrids, successfully grown in conditions of plastic and glass greenhouses. Noteworthy are the following varieties: Soniachny – early-ripening, yellow-red color of ripe fruit; Lysko – early-ripening, yellow color of ripe fruit; Dobirny – middle ripening, large cube-like dark red fruit in the ripeness phase; hybrid F_1 Anika – middle early with large fruit, dark red in the phase of biological ripeness.

Гени репродуктивної системи роду *Capsicum* та пошуки шляхів їхнього використання за умов захищеного ґрунту України

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Перець (рід *Capsicum*) є однією з найважливіших овочевих і пряних культур у світі. Роботи з вивчення генетики перцю виконуються постійно. Стають відомими нові гени, генетичні маркери, досконаліше вивчають раніше відкриті. **Мета**. Метою цієї роботи було описати та систематизувати існуючі на сьогодні гени репродуктивної системи рослин роду *Capsicum* і висвітлити питання щодо використання рецесивних мутантних генів у селекційному процесі при створенні нових сортів і гібридів перцю солодкого. **Методи**. Для класифікації репродуктивних генів у селекційних дослідженнях використано світову колекцію перцю солодкого, існуючі сорти і гібриди різних країн, власний селекційний матеріал. Експерименти здійснювали за умов плівкових і скляних теплиць згідно із сучасними методиками. **Результати**. Отримані дані систематизовано в такі групи генів: функціональної і генетичної стерильності, цитоплазматичної чоловічої стерильності, відновлення фертильності, жіночої фертильності та відповідальні за процеси цвітіння. Частину описаних генів можна використовувати в селекції на гетерозис та при створенні оригінального вихідного матеріалу. Наведено приклади застосування рецесивних мутантних генів при розробці нових сортів і гібридів перцю солодкого, а також їхні короткі характеристики. Нові сорти і гібриди перцю солодкого занесено до Державного реєстру сортів рослин, придатних до використання в Україні. **Висновки.** Охарактеризовані гени можна застосовувати в генетичних і селекційних дослідженнях. За участі рецесивних мутантних генів створено низку нових комерційних сортів і гібридів перцю солодкого.

Ключові слова: перець, ген, селекційний процес, репродуктивна система, стерильність, фертильність.

Гены репродуктивной системы рода *Capsicum* и поиски путей их использования в условиях защищенного грунта Украины

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Перец (род *Capsicum*) – одна из важнейших овощных и пряных культур в мире. Роботы по изучению генетики перца ведутся постоянно. Становятся известными новые гены, генетические маркеры, более досконально изучают ранее открытые. **Цель**. Целью данной работы было описать и систематизировать существующие на сегодня гены репродуктивной системы рода *Capsicum* и прояснить вопрос относительно использования рецессивных мутантных генов в селекционном процессе при создании новых сортов и гибридов перца сладкого. **Методы**. Для классификации репродуктивных генов в селекционных исследованиях использовали мировую коллекцию перца сладкого, существующие сорта и гибриды разных стран, собственный селекционный материал. Эксперименты осуществляли в условиях пленочных и стеклянных теплиц согласно существующим методикам. **Результаты.** Полученные данные систематизированы в такие группы генов: функциональной и генетической стерильности, цитоплазматической мужской стерильности, восстановления фертильности, женской фертильности и ответственные за процессы цветения. Часть описанных генов можно использовать в селекции на гетерозис и при создании оригинального исходного материала. Приведены примеры применения рецессивных мутантных генов при разработке новых сортов и гибридов перца сладкого, а также их короткие характеристики. Новые сорта и гибриды перца сладкого занесены в Государственный реестр сортов растений, пригодных к использованию в Украине. **Выводы**. Охарактеризованные гены можно применять в генетических и селекционных исследованиях. С участием рецессивных мутантных генов создан ряд новых коммерческих сортов и гибридов перца сладкого.

Ключевые слова: перец, ген, селекционный процесс, репродуктивная система, стерильность, фертильность.

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